

Evaluation of the treatment of traumatic coxofemoral luxations in dogs using toggle pin technique

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Abstract: This study was performed on 11 dogs diagnosed with traumatic coxofemoral luxation. The direction of the luxations, the operation details, postoperative complications, and radiographic evaluation were recorded during the study. The study utilized the toggle pin technique, which provided open-reduction techniques for the treatment of coxofemoral luxations. Polyester multifilament braided sutures with commercial toggle pins were employed in three cases, whereas toggle pins obtained from Kirschner wire and monofilament nylon suture material were performed in eight patients. Clinical and radiographic monitoring of postoperative lameness, complications, pain, and infection were assessed and recorded for comparison. Postoperative relaxation was observed in two cases in which multifilament braided polyester suture material was performed without other complications. In the cases without relaxation, it was noted that the animals used their limbs comfortably on the 1st postoperative day, and their lameness scores were 0 on the 7th postoperative day. As a result of the findings, the toggle pin technique using monofilament nylon suture could effectively treat coxofemoral luxations in dogs.

Keywords: Dog, Luxation, Suture material, Toggle pin.

Köpeklerin travmatik koksofemoral luksasyonlarının toggle pin tekniği ile tedavisinin değerlendirilmesi

Özet: Bu çalışma, travmatik koksofemoral luksasyon tanısı konulan 11 köpekte gerçekleştirilmiştir. Olgulardaki luksasyonların yönü, operasyon detayları, operasyon sonrası oluşan komplikasyonlar ve radyografik görüntüleri kaydedildi. Çalışmada açık redüksiyon tekniklerinden birisi olan toggle pin tekniği kullanıldı. Olgulardan 3 tanesinde kullanıma hazır halde satılan toggle pin ve multifilament örgülü polyester, 8 hayvanda ise kirschner telinden yapılmış toggle pinler ile monofilament nylon suture materyali kullanıldı. Olguların postoperatif topallık skorlaması, komplikasyonlar, ağrı ve enfeksiyon yönünden klinik ve radyografik takibi yapıldı. Monofilament örgülü polyester suture materyali kullanılan iki olguda postoperatif reluksasyon görülürken, diğer olgularda herhangi bir komplikasyona rastlanmadı. Reluksasyon görülmeyen olgularda hayvanların postoperatif 1. günde ekstremitesini rahatlıkla kullandığı dikkat çekti ve postoperatif 7. gündeki topallık skorları 0 olarak belirlendi. Elde edilen bulgular sonucunda köpeklerin travmatik koksofemoral luksasyonlarında monofilament nylon suture kullanılarak uygulanan toggle pin tekniğinin oldukça etkili olduğu görülmüştür.

Anahtar Kelimeler: Köpek, Luksasyon, Suture materyali, Toggle pin.

Introduction

The hip joint is a diarthrodial joint composed of the acetabulum and femoral head. The ball-and-socket design provides the joint with a broad range of motion and stability. The ligamentum capitis ossis femoris, joint capsule, and dorsal acetabular rim serve as the primary stabilizers of the hip joint (Evans, 1993). Luxation occurs when at least two primary stabilizers lose their functional capacity (Holsworth and DeCamp, 2003; Smith et al., 1963). Coxofemoral luxation, which accounts for 90% of all luxation cases in dogs, is a common problem. Luxations are typically traumatic, and 60% of these traumas are caused by motor vehicle accidents (Demko et al., 2006; Trostel and Fox, 2020). As a result of trauma-induced forces and the gravitational pull of the gluteal and iliopsoas muscles, craniodorsal luxations occur most frequently (Basher et al., 1986).

Cranioventral, caudodorsal, and caudoventral luxations are less common and may be related to an avulsion fracture of the trochanter major coinciding with the luxation (Harari et al., 1984; Schrader, 1994).

Closed reduction is the first treatment technique for coxofemoral luxations, but the success rate for craniodorsal luxations ranged from 50 to 78%. Open reduction and stabilization may be considered if closed reduction cannot be performed, relaxation occurs after reduction, or if the dog has multiple injuries and requires urgent hip stabilization. Numerous surgical techniques have been described to treat coxofemoral luxations (Martini et al., 2001). Because of the coxofemoral joint's anatomical structure, applying a toggle pin is frequently preferred. This technique is effective

because it replaces the ligamentum capitis ossis femoris, which contributes to passive stability. It has been reported that patients undergoing toggle pin stabilization have a low relapse rate, and it is a beneficial technique, particularly for patients with polytrauma (Bone et al., 1984; Demko et al., 2006; Scott and McLaughlin, 2007).

This study evaluated the effectiveness of the materials used in toggle pin stabilization, relapse rates, and postoperative process.

Materials and Methods

Permission was obtained from the "Kırıkkale University Clinical Practices Ethics Committee," and the animal owners were informed about the study, and a consent form was obtained for this study. The study material consisted of 11 dogs presented to Kırıkkale University Veterinary Faculty Research and Application Hospital between June 2020-2022 with a complaint of lameness in the hind limbs, diagnosed with coxofemoral luxation and treated with toggle pins. In the clinical examinations, all of the dogs had unilateral coxofemoral luxation. There was no concurrent injury.

Anesthesia and analgesia: The dogs were premedicated with medetomidine hydrochloride (80 mcg/kg) (Domitor; Zoetis, Finland) and induced with ketamine HCl (5 mg/kg) (Ketasol 10%; Richterpharma, Austria) via intravenous (IV) route. Butorphanol (0.4 mg/kg) (Butomidol; Richterpharma, Austria) was administered as an analgesic via IV route. Afterward, the animals were intubated, and anesthesia was maintained with isoflurane (Adeka, Turkey). Intravenous Cefazolin sodium (22 mg/kg) (Eqizolin, Tüm Ekip Ilac AS, Turkey) was administered 30 min before the operation and in the perioperative period.

Operative Approach: According to Çetinkaya and Olcay (2011), some toggle pins used in operation were formed from Kirschner wires, while others were purchased ready-made and sterilized. The ligament capitis ossis femoris was replaced with a monofilament nylon or a polyester multifilament braided yarn.

Then a hole was drilled in the acetabular fossa with a 2.7 mm or 3.5 mm diameter drill depending on the size of the animals, and the toggle pin was pushed through the created hole into the canalis pelvis (Figure 1A and 1B). Thus, when the thread was pulled back, the toggle pin rested against the medial wall of the acetabulum (Figure 1C). Guidewire was used to tunnel from the fovea capitis to the third trochanter, and a 2.0 mm or 2.7 mm diameter drill was used depending on the animal's size (Figure 1D). Under the guidance of a 0.80 mm Kirschner wire, the

suture material attached to the toggle pin was fed through the tunnel (Figure 1E). After joint reduction, a button made of Kirschner wire was used to secure the end of the monofilament nylon to the proximal lateral surface of the femur at the level of the third trochanter (Figure 1F). As stated in the literature (Wardlaw and McLaughlin, 2018), the objective was to preserve joint reduction until the formation of periarticular fibrous connective tissue. Monofilament nylon was used as suture material, and polyester multifilament braided thread in 8 and 3 dogs, respectively.

Postoperative Care and Control: All animals received subcutaneously 0.2 mg/kg meloxicam (Bavet; meloxicam; Turkey) for five days, to avoid postoperative pain and administered orally 12.5 mg/kg amoxicillin clavulanic acid (Synulox; Zoetis, Finland) for one week. No support material was applied to the extremity, and patients were advised to restrict movement for three weeks. Postoperatively, the Elizabethan collar was used for ten days (until the sutures were removed) to prevent the risk of suture damage. Clinical examinations and control radiographs were taken at 1, 2, 4 weeks, and two months postoperatively to evaluate the joint status. Pain, infection, crepitation, and degree of lameness were also checked. The differences between the animals were evaluated with the findings obtained. Postoperative lameness scoring was numbered from 0 to 5 (0: no lameness, 5: no weight bearing on the limb) according to a previous study (Ramirez et al., 2015).

Results

The average age of the different breeds and sexes of operated animals was 19.2 months (min:5-max:38), and their average body weight was 20.5 kg (min:11-max:28). On average, surgical intervention was performed 2.55 days (min:1-max:4) after trauma. Seven operated animals were male, and four were female. Breeds of dogs were Golden Retriever (n=2), Crossbreed (n=5), Pointer (n=1), Chow Chow (n=1), Staffordshire (n=1), and Cane Corso (n=1). Craniodorsal luxation was detected in all patients. Congenital hip dysplasia was observed in one patient (case 11). No orthopedic abnormality except for luxation was observed in the other animals. In three of the animals (cases 4, 6, and 7), toggle pins made of commercially available polyester multifilament braided yarn were used (Table 1). In two of the animals (cases 4 and 6, in which polyester multifilament braided yarn was used), lameness was observed four and five days after the operation, and reluxation was detected in the radiographic examination (Figure 2). Caput femoris degenerations were discovered during the reoperation on these

two patients, and it was decided to perform excision arthroplasty. Patients who did not experience relaxation began using their extremities on the 1st postoperative day, and no abnormality was postoperatively observed in the radiographic and

clinical examinations in the following weeks (Figures 3 and 4). Median scores of lameness was 1 (range 0-5) on the first day and was 0 on the seventh day postoperatively ($P=0.008$) for nine patients without relaxation. (Table 2).



Figure 1. A) A hole was drilled in the acetabular fossa. B) Toggle button advanced into the acetabular hole. C) Toggle button seat on the medial wall of acetabulum. D) A guidewire placed from fovea capitis to third trochanter and bone tunnel was created. E) Passing the toggle suture material through the femoral bone tunnel. F) Knotting of the suture material at the level of the third trochanter after reduction.

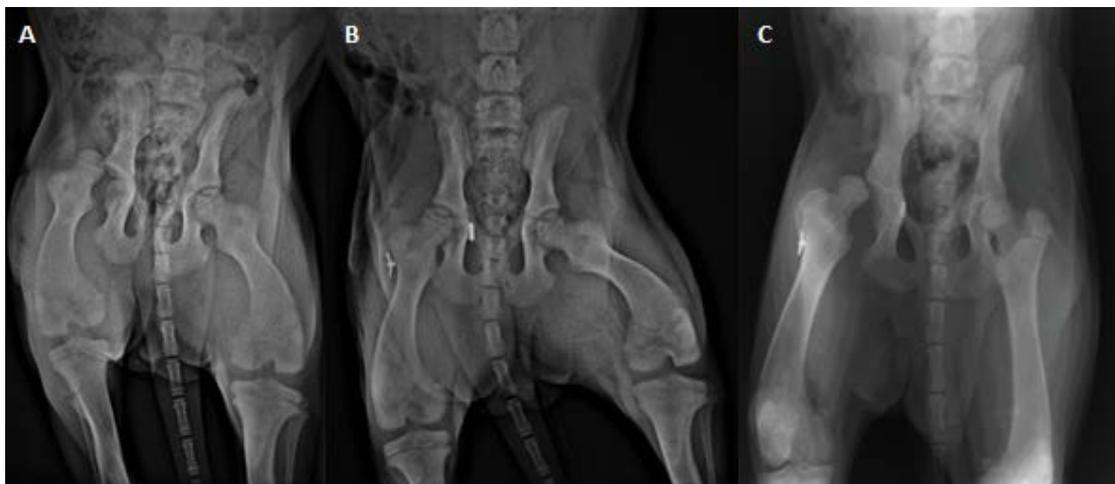


Figure 2: Ventrodorsal radiographic images of case 4, A) preoperative, B) immediately after surgery, C) 5th day after surgery.



Figure 3: Ventrodorsal radiographic images of case 9, A) preoperative, B) immediately after surgery, C) 2 months after surgery.



Figure 4: Ventrodorsal radiographic images of case 11, A) preoperative, B) immediately after surgery, C) 14th day after surgery.

The animal was placed in the supine position with the injured limb on top. The operation area was shaved, decontaminated, and prepared for aseptic surgery. A craniolateral approach involved external rotation and adduction of the extremity in reaching the hip joint. The acetabulum was cleared of debris, hematoma, fibrin, granulation tissues, and the remnants of the detached ligament capitis ossis femoris.

Discussion

Different reduction techniques, including intra- and extra-capsular, have been reported in coxofemoral luxations (Ash et al., 2011; Demko et al., 2006; Rocherau and Bernard, 2012; Venzin and Montazon, 2007) and some studies are recommend using different suture materials in toggle pin fixation one of these techniques (Bone et al., 1984; Çetinkaya and Olcay, 2011; Hoim et al., 2005; Martini et al., 2001). In the study by Spranklin et al. (2006), the weight-bearing capacities of various materials were

examined in the toggle pin technique applied to cadavers and They reported that monofilament suture material could not support a weight of 40 kg, causing damage to the line on the caput femoris and causing it to rupture. Demko et al. (2006) used monofilament nylon sutures in large breed dogs and reported very low (11%) relaxation problems. In all studies, toggle pin or rod fractures, ruptures in the prosthetic ligament, fractures of the caput femoris or colum femoris, and related relaxations were reported as primary complications. Infection and sinus formation are said to be related to the artificial ligament material used. Relaxation cases are reported to occur within two weeks postoperatively (Kieves et al., 2014; Martini et al., 2001; Trostel and Fox, 2020). Previous studies have reported that polyester multifilament braided rope is more elastic and resistant to stretching thanks to its knitting structure (Martini et al., 2001). A previous study conducted by Çetinkaya et al. (2011) reported that monofilament nylon was more durable than braided ropes in coxofemoral luxations in their study. Another study stated that there was no difference

Table1: Details and clinical outcomes of 11 dogs postoperatively.

Case	Breed	Sex	Age (month)	Body Weight (kg)	Luxation direction	Duration of luxation (day)	Toggle suture material	Evaluation of outcomes postoperatively
1	Mix Breed	M	17	18	CD/R	3	Monofilament nylon	Excellent
2	Golden Retriever	F	13	25	CD/L	3	Monofilament nylon	Excellent
3	Mix Breed	M	11	22	CD/L	4	Monofilament nylon	Excellent
4	Cane corso	M	5	11	CD/R	2	Polyester multifilament braided	Reluxated (5th day)
5	Stafford shire terrier	M	12	28	CD/L	2	Monofilament nylon	Excellent
6	Mix Breed	F	26	20	CD/L	1	Polyester multifilament braided	Reluxated (4th day)
7	Mix Breed	M	38	21	CD/R	3	Polyester multifilament braided	Excellent
8	Golden retriever	M	18	23	CD/L	2	Monofilament nylon	Excellent
9	Mix Breed	F	24	19	CD/L	2	Monofilament nylon	Excellent
10	Pointer	F	23	18	CD/L	3	Monofilament nylon	Excellent
11	Chow Chow	M	24	20	CD/R	3	Monofilament nylon	Excellent

Table2: Lameness scores at the 1st and 7th day postoperatively.

	Case1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
Post-op 1st day	2	1	2	1	1	1	2	1	2	2	1
Post-op 7th day	0	0	0	5	0	5	0	0	0	0	0

between braided polyester ropes and monofilament nylon (Flynn et al., 1994). We used monofilament nylons and polyester multifilament braided ropes as artificial ligament materials in toggle pin applications, frequently used in coxofemoral luxation cases. We observed that the monofilament nylon was more durable than polyester multifilament braided rope and could be successfully applied in animals under 30 kg. This study determined that the monofilament nylon did not break in the postoperative period, and the animals still used the relevant leg very comfortably in the second month of control. The findings are in good agreement with the study of Çetinkaya et al. (2011). We suggested that using monofilament nylons in intra-articular stabilization is more satisfactory than polyester multifilament braided yarn. No radiographic or clinical evidence of osteoarthritis was found in the second month of postoperative follow-up. It should be noted, however, that dogs weighing no more than 30 kg were used in this research. In accordance with previous studies, postoperative relaxation occurred within the first week after surgery in cases where polyester multifilament braided yarn was utilized. This is believed to be because polyester multifilament braided threads are less flexible than monofilament nylons and may deteriorate more rapidly when in contact with bone.

In coxofemoral luxations, the duration of the operation is an essential factor in preventing caput femoris damage, achieving reduction, and reducing the risk of relaxation. It has been reported that the longer the reduction time, the greater the risk of caput femoris damage and abnormal formations in the acetabular fossa, such as fibrin and granulation tissue (Matthews ve Bernhart, 2021). In the present study, animals were operated on within the fourth post-traumatic day. No damage to the caput femoris was found at the time of the operation. Of the two cases with relaxation, one was operated on the second day and the other on the first day. However, the reason for recurrence is thought to be the low durability of the suture material because no recurrence was observed in the repair performed with the monofilament nylon.

In the review by Trostel and Fox (2020), it is emphasized that the toggle pin technique has been the most common treatment for coxofemoral luxations in recent years, but the relapse rate has not decreased below 10% despite the use of different materials. In another study involving 128 dogs with coxofemoral luxation, the relaxation rate for toggle pin stabilization with monofilament nylon suture material was determined to be 24.2%. (Matthews

and Bernhart, 2021). In this study, material-induced luxation was observed in animals with polyester multifilament braided yarn. No luxation was observed in animals with monofilament nylon suture material, and the rate of luxation was similar to Matthews and Bernhart (2021).

It has been reported that toggle pin stabilization in coccafemoral luxations gives positive results as long as no relaxation occurs. The most recently reported relaxation rate following toggle pin stabilization in large breed dogs (over 60 kg) was reported to be 11%, and monofilament nylon suture was used in 96% of cases (Trostel and Fox, 2020). In the study, it was observed that the animals weighed an average of 20 kg, and it was noteworthy that the animals with relaxation were animals weighing less than 20 kg. In addition to weight, it is believed that the flexibility and tensile strength of the material used are much more significant in the formation of relaxation.

Coxofemoral joint luxations have historically been treated with the Toggle pin technique. Although different materials have been tried in the studies, the weight and skeletal structure of the animal are among the factors that influence success. In this study, the lower recurrence rate of the line used for Toggle pin application compared to the polyester multifilament braided yarn mentioned in the literature is deemed to be a significant finding. It is believed, however, that stronger results will be obtained when supported by studies involving a greater number of animals and longer postoperative monitoring.

Conflict of Interest

The authors stated that they did not have anyreal, potential or perceived conflict of interest.

Ethical Approval

This study is not subject to HADYEK permission in accordance with Article 8 (k) of the "Regulation on Working Procedures and Principles of Animal Experiments Ethics Committees".

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